HISTORY OF FATHERS OF MATHEMATICS

EKURE OGHENEYOMA JOHN

H.WEBER

Heinrich Friedrich Weber(1842—1913)

Heinrich Weber (1842—1913) was born on May 5, 1842, in Heidelberg, Germany. In 1860, he studied mathematics and physics at the University of Heidelberg. He received his Ph.D. in 1863. He was appointed as extraordinary professor at the University of Heidelberg in

1869 and also taught at Edgenössische Polytechnikum in Zurich, the University of Königsberg, the Technische Hochschule in Charlottenburg, and the universities of Marburg, Göttingen, and Strasbourg. Weber was a friend of Richard Dedekind and they often collaborated. Together they edited the work of Riemann in 1876. Herman Minkowski and David Hilbert were among Weber's students. Weber's main research interests were in analysis and its applications to mathematical physics and number theory. He was encouraged by VonNeumann to investigate physical problems and by Richelot to study algebraic functions. Along the lines of Jacobi, he worked on the theory of differential equations. He proved Abel's theorem in its most general form. He also worked on physical problems concerning heat, static and current electricity, the motion of rigid bodies in liquids, and electrolytic displacement. Weber's most profound and penetrating work is in algebra and number theory. He, jointly with Dedekind, did work of fundamental importance on algebraic functions. In 1891, Weber gave the "modern" definition of an abstract finite group. One of his outstanding accomplishments was the proof of Kronecker's theorem, which states that "absolute

Abelian fields are cyclotomic". Weber was an enthusiastic and inspiring teacher who took great interest in educational questions. He died on May 17, 1913.

L. KRONECKER

Leopold Kronecker (1823—1891)

Leopold Kronecker (1823—1891) was born on December 7, 1823, in Liegnitz, Germany, to a wealthy family. He was provided with private tutoring at home. He later entered Liegnitz Gymnasium, where E. E.

Kummer was his mathematics teacher. Kummer recognized his talent and encouraged him to do independent research. In 1841, he matriculated at the University of Berlin. There he attended Dirichlet's and Steiner's mathematics lectures. He was also attracted to astronomy and in 1843 attended the University of Bonn. He returned to Berlin in 1845, the year he received his Ph.D. His thesis was on complex units. On Kummer's nomination, Kronecker became a full member of the Berlin Academy in 1861. He was very influential at the Academy and personally helped fifteen mathematicians, including Riemann, Sylvester, Dedekind, Hermite, and Fuchs, to get various memberships. Kronecker's primary work is in algebraic number theory. He is believed to be one of the inventors of algebraic number theory along with Kummer and Dedekind. He was the first mathematician who clearly understood Galois's work. He also proved the fundamental theorem of finite Abelian groups. Briefly Kronecker withdrew from academic life to manage the family business. However, he continued to do mathematics as a recreation. In 1855, he returned to the academic life in Berlin. In 1880, he became editor of

the Journal für die reine and angewandte Mathematik.

Kronecker and Weierstrass were good friends. While Weierstrass and Cantor were creating modern analysis,

Kronecker's remark that "God himself made the whole numbers–everything else is the work of men" deeply affected Cantor, who was very sensitive. His remarks in opposition to Cantor's work are believed to be a factor in Cantor's nervous breakdown. Kronecker died on December 29, 1891.

J.L. LAGRANGE

Joseph Louis Lagrange (1736—1813)

Joseph Louis Lagrange (1736—1813) was born on January 25, 1736, in Turin, Italy. He spent the early part

of his life in Turin. While there he was involved in carrying out research work in calculus of variations and mechanics. In 1766, Lagrange was invited by the Prussian king, Frederick II, to fill the position vacated by Euler in Berlin. Frederick the Great proclaimed in his appointment that "the greatest king in Europe" ought to have "the greatest mathematician in Europe." In 1787, after the death of Frederick II, he went to Paris, accepting an invitation from Louis XVI. In 1797, he accepted a position at the newly formed École Polytechnique in Paris. He was made a count by Napoleon and remained at the École Polytechnique till his death. Throughout his life, Lagrange did work of fundamental importance. He made numerous contributions to many branches of mathematics, including number theory, the theory of equations, differential equations, celestial mechanics, and fluid mechanics. In 1770, he proved the famous Lagrange's theorem in group theory. He is responsible for the work leading to Galois theory. In his paper, "Réflexion sur la théorie algébriques des équations," Lagrange carefully analyzed the various known methods to solve a polynomial equation of degree = 4 by means of

radicals. He was interested in finding a general method of solution for polynomials of higher degree. He was unable to find a general solution, but in his paper he introduced several key ideas on the permutations of roots which finally led Abel and Galois to develop the necessary theory to answer the question. Lagrange's work on the solution of polynomial equations is one of the sources from which modern group theory evolved. He died on April 10, 1813

A. CAUCHY

Augustin-Louis Cauchy (1789— 1857)

Augustin-Louis Cauchy (1789— 1857) was born on August 21, 1789, in Paris, France. He received his first education from his father. He was a neighbor of Laplace

and Berthollet. Cauchy became acquainted with famous scientists at a young age. Lagrange is said to have warned his father not to show Cauchy any mathematics book before the age of seventeen. At the age of fifteen, he completed his classic studies with distinction. He became an engineer in 1810, in the Napoleon army. In 1813, he returned to Paris. In 1811, Cauchy started his mathematical career by solving a problem sent to him by Lagrange on convex polygons. In 1812, he solved Fermat's famous classical problem on polygon numbers. His treatise on the definite integral, which he submitted in 1814 to the French Academy, later became a basis of the theory of complex functions.

In 1816, he was appointed full professor at the École Polytechnique. More theorems and concepts have been named for Cauchy than for any other mathematician. There are sixteen concepts and theorems named for Cauchy in elasticity alone.

He worked on mathematics, mathematical physics, and celestial mechanics. In mathematics, he worked on several areas, such as calculus, complex functions, algebra, differential equations, geometry, and analysis. The notion of continuity used today was invented by

Cauchy. He also proved that a continuous function has a zero between two points where the function changes its signs, a result also proved by Bolzano. The first adequate definitions of indefinite integral and definite improper integral are due to Cauchy.

In algebra, the notion of the order of an element, a subgroup, and conjugates are found in his papers. He proved the famous Cauchy's theorem for finite groups, that is, if the order of a finite group is divisible by a prime p, then the group has a subgroup of order p. Cauchy's role in shaping the theory of permutation groups is
central. He is regarded by some to be the founder of finite group theory. The two-row notation for permutations
was introduced by Cauchy. He also defined the product of permutations, inverse permutations, transpositions, and the cyclic notation. He wrote his first paper on this subject in 1815, but did not return to it for nearly thirty years. In 1844, he proved that every permutation is a product of disjoint cycles.
He also did work of fundamental importance in the theory of determinants. His treatise on determinants, published in 1812, contains important results concerning product theorems and the inverse of a matrix.

Cauchy enjoyed teaching. He published more than 800 papers and eight books. He died on May 22, 1857.

N.H ABEL
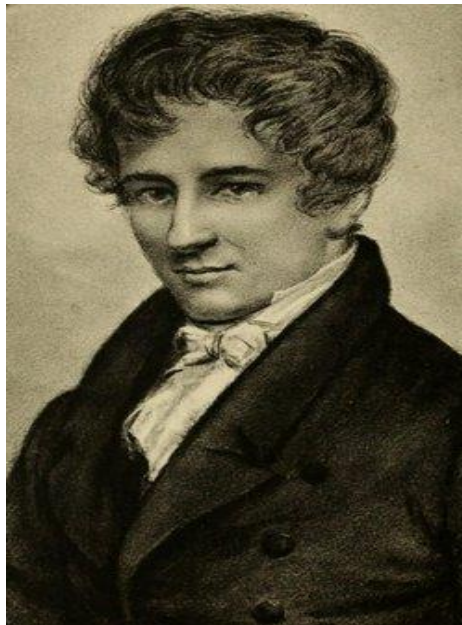
Niels Henrik Abel (1802—1829)

Niels Henrik Abel (1802—1829) was born on August 5, 1802, in Finnöy, Norway. He was the second of six children. Abel and his brothers received their first education from their father. At the age of 13, Abel along with his older brother, was sent to the Cathedral school in Christiania(Oslo). In 1817, his mathematics teacher was Bernt Michael Holmbë, who was seven years older

than Abel. Holmbë recognized Abel's talent and started giving him special problems and recommended special books outside the curriculum. Abel and Holmbë read the calculus text of Euler and the work of Lagrange and Laplace. Soon Abel became familiar with most of the important mathematical literature. Abel's father died when he was 18 years old and the responsibility of supporting the family fell on his shoulders. He gave private lessons and did odd jobs. However, he continued to carry out his mathematical research. Abel, in his last year of school, attacked the problem of the solvability of the quintic equation, a problem that had been unsettled since the sixteenth century. Abel thought that he had solved the problem and submitted his work for publication. Unable to find an error and understand his arguments, he was asked by the editor to illustrate his method. In 1824, during the process of illustration he discovered an error. This discovery led Abel to a proof that no such solution exists. He also worked on elliptic functions and in essence revolutionized the theory of elliptic functions. He traveled to Paris and Berlin in order to find a teaching position. Then poverty took its toll, and he fell ill with tuberculosis from which he died. Two days

later a letter from Crelle reached his address, conveying the news of his appointment to the professorship of mathematics at the University of Berlin. Abel is honored by such terms as Abelian group and Abelian function. Abel died on April 6, 1829.

A.CAYLEY

Arthur Cayley(1821—1895)

Arthur Cayley(1821—1895) was born on August 16, 1821, in Cambridge, England. He was the second son. He entered Trinity College at the age of 17, as a pensioner. In 1842, he graduated as senior wrangler. Later he went to a law school and in 1849 he became a lawyer. As a lawyer, he made a comfortable living and in fourteen

years, during which he practiced his law profession, he wrote approximately 300 mathematical papers.

In 1863, Cayley was elected to the new Sadlerian chair of pure mathematics at Cambridge, where he remained until his death. For most of his life, Cayley worked on mathematics, theoretical dynamics, and mathematical astronomy. In 1876, he published his only book, Treatise on Elliptic Functions. Cayley wrote 966 papers; there are thirteen volumes of his collected papers. Cayley's mathematical style was terse. He usually wrote out his results and published them without delay. He, along with J. J. Sylvester, his lifelong friend, is considered to be the founder of invariant theory. He is also responsible for matrix theory. The square notation used for determinants is due to Cayley. He proved many important theorems of matrix theory, such as the Cayley-Hamilton theorem. He is one of the first mathematicians to consider geometry of more than three dimensions.

In 1854, Cayley published, "On the theory of groups depending on the symbolic equation $\theta n = 1$." In this paper, he considered a group as a set of symbols, 1, α, β, . . . , all of them different and such that the product of

any two of them (no matter in what order), or the product of any one of them into itself, belongs to the set. This formulation of a group as a set of symbols and multiplications is different from the formulation considered by the earlier mathematicians. The paper is generally regarded as the earliest work on abstract group theory and Cayley is regarded as the founder of abstract group theory. He is best known for the theorem that every finite group is isomorphic to a suitable permutation group. In his article of 1854, he introduced a procedure for defining a finite group by listing its elements in the form of a multiplication table, known as a Cayley table. Cayley also proved a number of important theorems.

He died on January 26, 1895.

SRINIVASA RAMANUJAN

Srivanasa Ramanujan(1887-1920)

Srivanasa Ramanujan was born on 22 December 1887. He had no formal training of any sort in pure mathematics, however, he made substantial contributions to mathematical analysis, continued fractions , infinite series, and number theory including solutions to mathematical problems then considered unsolvable.

He sought to come impress the foremost mathematicians of his day with his work but they were most likely discouraged by his presentation which was quite novel. Eventually, an English Mathematician: G.H Hardy got interested in his work and partnered with Ramanujan bringing him to the University of Cambridge, England.

Although he had a short lifespan, he compiled over 3900 results in number theory, mathematical analysis as well as others. His most notable discoveries include Ramanujan prime, the Ramanujan theta function, partition formulae and mock theta functions; which has opened research in diverse areas upon further research. Of particular interest however is the lost notebook of Ramanjan which was rumored to contain results from the last year of his life(1919-1920). The notebook, when discovered in 1976 caused a big stir in the mathematical world. The book contains over 600 mathematical formulas consecutively without proof which covered a wide range of topics including q-series, modular equations, singular moduli and mock theta functions which have recently been found useful in calculating the entropy of black holes.

He was one of the youngest members of the Royal society and the first Indian to be elected a Fellow of Trinity College, Cambridge. He died on 26th April 1920. A

movie was recently produced based on his life, titled,
"The man who knew Infinity".

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